Effectiveness of Forensic Evidence in Criminal Administration of Justice: A categorical analysis with special reference to Bharatiya Sakshya Adhiniyam, 2023

A

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I, **Mr. Ashwani Kumar**, declare that the synopsis entitled, **"Effectiveness of Forensic Evidence in Criminal Administration of Justice: A categorical analysis with special reference to Bharatiya Sakshya Adhiniyam, 2023"** being submitted in the partial fulfillment of the requirement for the award of the degree of Doctor of Philosophy in **Law** under ICFAI Law School, The ICFAI University, Dehradun during the academic year 2024-25.

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ABSTRACT

"CUILIBET IN ARTE SUA PERITA CREDENDUM EST"- Any skilled person is to be believed in his own art. Since the 20th century has seen so many important developments in science and technology, it has been referred to as the "era of science." Forensic science schools, in India, got working in the early nineteenth century, and their network branched out throughout the twentieth century, continuing to grow into the twenty-first century. To support the criminal justice system and accelerate the resolution of criminal cases through laboratory and field investigations, various forensic facilities have been established. However, the rapid increase in the criminal cases has surpassed the capacity of these forensic facilities and therefore, to modernize the forensic practices in Indian judicial system, it seems necessary to develop additional workforce infrastructure, advanced scientific tools, and cutting-edge science and technology.

Despite continuous efforts towards enhancing manpower, equipment, and infrastructure for modernising forensics in India, there is still a need for further capacity building in the field and therefore the proposed research work emphasis on evaluating the current legal frameworks, challenges and issues within the Indian justice delivery system, academic and research activities, future directions set by the apex courts, and the evolving requirements for forensics in India, proposing a comprehensive discussion of these issues.

The work proposes to discuss the crole of forensic evidence in the Indian Juidical system and necessity of the Bharatiya Sakshya Adhiniyam, 2023. The work will also evaluate how various types of forensic evidence such as chemical, biological, physical, and digital, can increase the accuracy of various investigations via forensic evidence and hence the outcomes of court cases. The proposed work will explore the legal framework of the Bharatiya Sakshya Adhiniyam, highlighting the procedures for the admission, collection, and preservation of forensic evidence. It will also addresses the different challenges such as contamination risks and potential biases in interpretation while highlighting the value of forensic evidence in improving law enforcement effectiveness and reducing wrongful convictions. Furthermore, the proposed work will also explore the importance of public trust in the justice delivery system and the influence of forensic evidence on sentencing and appeals.

1. INTRODUCTION

The word "forensic" appeared from the Latin term for the public forum, in the ancient Rome where political and policy matters were deliberated, and the Senate convened. The term "forensic" refers to the issues concerning the public. However, when used in the context of 'forensic science', the term refers to the profession of scientists who are liable to provide the reports and testimony to the court/judiciary system while addressing legal matters and hence, one can say that the forensic science is the implication of scientific principles in legal issues. In 1902, Sir William Herschel highlights the use fingerprint evidence for identification in criminal cases in Argentina which later became the first country to use forensic evidence in a criminal case. Forensic evidence is a critical part of the global justice system which represents the fusion of science and the law.

For a fair judgment, forensic evidence has not yet found a paramount role as they are considered secondary evidence. It depends upon all branches of science i.e., biology, chemistry and physics. It is also employed for a variety of other objectives, including the investigation of criminal and civil matters and the examination of violent crimes including rape, murder, and drug trafficking. Modern technology including DNA testing, fingerprint profiling, narcotics testing, and polygraph tests are all included in forensic evidence, which helps the nation's justice delivery system. "Modern scientific development has made a serious impact on the law of evidence in several areas such as blood stains, blood group, alcohol and breath test in case of traffic accident tape recording, automatic photographs, computers, identification of fibres including human hairs, arson investigation, truth drugs and lie detector, finger and footprints, and even hypnotism, the law of evidence tries to stay up with the scientific knowledge and utilize its result to arrive at the truth"[1]. The word forensic evidence is not specified in the Indian statutes but the word ***evidence*** has been defined in the Indian Evidence Act, 1872 under section 3[2] which says that,

"E*vidence means and includes: (1) all statements made by the witnesses in front of the Court with its permission or when the court requires that, about the facts being investigated; these statements are referred to as oral evidence; and (2) Every document, including electronic data, prepared for the Court's review or which are produced before the court of law for inspection is referred to as documentary evidence.*"

Under Section **2 (1) (e) of Bharatiya Sakshya Adhiniyam, 2023** Evidence has been defined as, "*evidence means and includes: (i) all statements including statements given electronically which the Court permits or requires to be made before it by witnesses in relation to matters of fact under*

[1] Law of Evidence, 7th Edition, Vepa. P. Sarathi, pg 221.
[2] Section 3, Indian Evidence Act 1872.

inquiry and such statements are called oral evidence; and (ii) all documents including electronic or digital records produced for the inspection of the Court and such documents are called documentary evidence."

Section 45[3] explained the phrase "Science and Art," which contains the view of the expert that has been reached based on his science. In Section 45 of the Indian Evidence Act,1872, an ***Expert*** is defined as,

"a person who possesses specialised knowledge, skill, or experience in any of the following areas, such as those relating to medical officers, chemical analysts, explosive experts, ballistic experts, fingerprint experts, etc."

Section 39. (1) of Bharatiya Sakshya Adhiniyam, 2023 explains the phrase '***Expert opinion'*** as follows

"when the Court has to form an opinion upon a point of foreign law or of science or art, or any other field, or as to identity of handwriting or finger impressions, the opinions upon that point of persons specially skilled in such foreign law, science or art, or any other field, or in questions as to identity of handwriting or finger impressions are relevant facts and such persons are called expert".

"Under Section 45A of the Indian Evidence Act 1872, the opinion of the Examiner of Electronic Evidence is also important when it comes to experts' opinions."

Without independent and reliable rationale, the evidence of an expert is a weedy type of evidence and courts consider it unsafe to rely on it[4]. Therefore, the court is not assured by the opinion of an expert but it has to form its own opinion. Admissibility of Expert opinions always depends upon possibilities of truthiness.

There were provisions like Section 156 read with Section 157 of the Indian Evidence Act and Section 293 of the Criminal Procedure Code which show that the expert opinion or other kinds of scientific evidence must be corroborated by the court before their admissibility, as observed in **Buckley v. Rice Thomas[5].**

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[3] Section 45, Indian Evidence Act 1872
1) foreign law,
2) science
3) art
4) handwriting or
5) finger impression and such knowledge has been gathered by him—
a) by practice,
b) observation or
c) proper studies.

[4] S Gopal Reddy v. State of Andhra Pradesh (1996) 4 SCC 596.

[5] (1554) 1 Plowd 118.

In Bharatiya Sakshya Adhiniyam, Sections 159 read with Section 160 and Section 329 of Bharatiya Nagarik Suraksha Sanhita 2023 prescribe the same procedure.

CRIMINAL JUSTICE SYSTEM AND EVIDENCE

The justice delivery system in criminal law is a fair process in which any victim of crime is awarded fair justice. In criminal proceedings, the said process always commences from investigation to judgment. Need for evidence is always required from investigation to trial. These all things are known as the administration of justice. 'Having a law is not enough, the law needs to be interpreted and applied' same during imparting justice having evidence is not enough but the evidence must be effective, reliable and probative.

The main purpose of a Criminal Justice System is to have one of the goals of improving, providing justice for all (also known as due process) so that convicted criminals can be brought to justice just deserts theory states that those convicted should be punished appropriately. The system assists convicted criminals (such as probation and restorative justice). A law-abiding society requires both justice and prisons) to stop future crimes even after they have served their sentence. Developing criminal justice systems also improves public safety. The Criminal Justice System assists victims of crimes, as well as protects the innocent and the vulnerable. (For example, children). Detecting and prosecuting criminal activity is also the responsibility of the Criminal Justice System, with the police force being the primary law enforcement agency. In the courts, there is a purpose (e.g., collecting fines) to execute court orders and sentence fairly without prejudice.

A BRIEF HISTORY AND PLETHORAS OF FORENSIC EVIDENCE

The word "forensic" is iriginated from the Latin word "forum," which means "public place." In ancient Rome, the Senate convened in the Forum, a public space where political and policy concerns were discussed and debated. In a technical sense, "forensic" refers to as applied to the public or issues. When used together, the phrase "forensic science" is pertinent to describe the profession of a scientist whose work provides the court with answers through reports and testimony. Therefore, forensic science would refer to the science employed in legal proceedings.

Forensic Identification by DNA Profiling Technique (DNA tests)

Deoxyribonucleic acid is the abbreviation for DNA. Genes make up all living things in the body. The protein is found only in white blood cells and not red blood cells. The genetic identification of all human beings is proceeded by the DNA, so their behaviour character, body structure and

characteristics are determined by DNA. Every human being possesses own unique DNA structure. In the Monozygotic twin's case, DNA is generally identical. In 1984, Sir Alec Jeffrey developed the technique for using DNA to identify people, and the UK police utilised forensic DNA profiling for the very first time in the year 1985.

Ballistics

Ballistics is defined as the study and application of weaponry. In the modern world, it is very easy to inspect guns, ammunition, and other associated materials due to the scientific progress of ballistics. The word "ballistics" refers to the study of how a bullet travels from a weapon through the air and into a target. However, the process of connecting the recovered bullets and hence their casings to the firearm from which they were shot is known as "ballistics" in criminal investigations.

The identification of firearms is often considered to be a division of tool mark identification. A specialist in tool markings makes an effort to match the marks left by instruments like crowbars and screwdrivers to the objects they were employed on. Ballistics experts are more than just experts in tool marks. They usually testify on the matters ranging from whether a specific object is, legally, a firearm to elaborate reconstructions of crime scene evidence because they are specialists in many different elements of firearms. Calvin Goddard, a pioneer in this field, invented the forensic ballistic for the first time. In Jurnail Singh v. the State of Punjab,[6] it was ruled by the Supreme Court that there was no need of expert evidence in the case of the double-barrel gun which could be fired by first filling it with gun powder. In the case of Sukhpal v. the State of Haryana,[7] the accused was found in possession of rifles and cartridges for which he had no license, it was observed that making of test of firing by the expert for purpose of ascertaining whether or not the rifle was capable of firing is not at all necessary.

Fingerprints

"Fingerprints are God's seals, given to us that we may recognize his greatest creation-MAN." The best and certain method of identification was fingerprinting which was discovered during the fag end of the nineteenth century till the advent of a similar method DNA Fingerprinting. In criminal investigations, fingerprints are more valuable due to various reasons. The unique traits such as permanence, universality, inimitability, classifiability, are possessed by such fingerprints and they are frequently used for the establishment of relation and link between suspected persons and

[6] AIR 1999 SC 321
[7] AIR 1995 SC 578

commission of offences. The distinct characteristics of fingerprints are- they are permanent in nature, universal applicable, original, classifiable, and consistently used as best evidence in criminal cases. At the crime scene, the incriminating evidence are discovered with the help of latent fingerprints. With the help of chemical or physical techniques, the experts collect these prints, after that it is examined and distinguished by latent fingerprint examiners. Later on, these fingerprint images are entered into an "Automatic Fingerprint Identification System (AFIS)", which helps to investigating agencies search large databases for matches. AFIS is comprehensively used by criminal justice organisations, however, nonetheless not available in India. It collects and scores fingerprint images in an organized, searchable database for individuals who have been arrested or incarcerated.

There is a dispute regarding the inventor of fingerprints. In the literature, many have accepted that Henry Faulds is the first who invented the Fingerprint. Though there is evidence that fingerprints have been used since ancient times, the English first started utilizing them in July 1858 when Sir William Herschel, the Chief Magistrate of the Hoogly District, used them for the first time on local contracts.

Forensic Toxicology:-

Toxicology is used in forensic toxicology together with other fields, including clinical chemistry, analytical chemistry, and pharmacology, to assist the concerned in the medical or legal investigations into drug use, poisoning, and death. In forensic toxicology, superior importance is always given to method and the technology which are utalized to collect and analyze than the legal conclusion drawn in toxicological investigation. Different types of samples can be used for toxicological examination. Mathieu Orifila, who was a Spanish distinguished scientist and many accepted as "founder of Toxicology" because he published the first thorough work on forensic toxicology in 1813. His writings focused on the necessity of sufficient identifying proof and quality control. Furthermore, in the sectors of pharmaceuticals, medicine, industry, and the environment, the use of forensic toxicology was acknowledged by his writings.

The deception detection tests (DDT)

The deception detection method is applied where investigating agencies are unable to collect or gather the ocular evidence from the witnesses, and in some exceptional circumstances there is no witness available at the place where the crime has occurred, only the accused person or the prime culprit is the sole person present at the scene, then a Deceptive test is applied upon the accused

person, culprit and sometimes upon the prime witness to the crime scene to collect the evidence upon which the prosecution can be initiated.

The deception detection tests DDT includes the following scientific methods such as:

(1) polygraph,

(2) narco-analysis

(3) brain-mapping

The DDTs are helpful to know the concealed facts related to crime. These processes roll with significant clinical, scientific, ethical, and legal implications. Most of the cases, the only person with access to this information is the subject of a criminal investigation. Investigative agencies often imply DDTs (Direct Data Techniques), but they are well aware that due to legal prohibition such information cannot be used as evidence in court during trial. It is debatable and supported by many that these techniques are less harmful than traditional "third-degree methods used by investigating agencies. Many argue that using these "scientific processes" can directly help investigative authorities in collecting critical evidence, ultimately increasing the probability of prosecuting the guilty and exonerating the innocent.

It also recognised the application of forensic toxicology in the fields of pharmaceuticals, medicine, business, and the environment.[8]

HIGH COURTS ON NARCO ANALYSIS AND BRAIN FINGER MAPPING TEST VALIDITY

The Bombay,[9] Madras,[10] Kerala,[11] Gujarat,[12] Andhra Pradesh[13] and Allahabad,[14] High Courts held the Narco-analysis and use of P300 or brain-finger printing, lie-detector tests and use of mouth serum to be valid under Article 20(3) of the constitution of India. The High Court of Karnataka [15] held it not to be constitutional.

[8]Selvi v. State of Karnataka AIR 2010 SSC 1974

[9] Ram Chandra Reddy v. the State of Maharashtra, 2004 ALL MR (Cr) 1704.

[10] Dinesh Dalmia v. State, 2006 Cr LK 2401 Mad.

[11]Rajo George v. Dy Supdt. Of Police, 2066 (2) KLT 197.

[12]SantokhbenSharmnbhaiLadeja v. State of Gujarat, 2007 Cr LJ 4566.

[13] State of A.P. v. Inapuri Padma, 2008 Cr LJ 3992 (AP).

[14] Abhay Singh v. State of U.P.,2009 Cr LJ 2189 (All) (Lko Bench).

[15] AIR 2010 SSC 1974.

SUPREME COURT ON NARCO TEST

The Supreme Court, in Selvi v. the State of Karnataka,[16] in a bench of Criminal appeals relating to the involuntary narco-analysis, polygraph examination and the brain electrical activation profile (BEAP) test to improve investigation in criminal cases summarized the legal position and held 'Forcing a person to comply with any of the standards of 'substantive due process which is mandatory for restraining personal liberty. Such violation will occur regardless of whether these procedures have used forcibly during any inquiry, or for any other reasons, because the test finding may expose a person to non-penal repercussions. The so-called techniques must not be interpreted into the statutory provisions which empowered medical examination during investigation in criminal cases, i.e. the explanation to Sections 53, 53-A and 54 of the Code of Criminal Procedure, 1973.

Owing to the principles of ejusdem generis and the considerations governing how to interpret scientific advancement statutes, such an expansive interpretation is not possible. An individual's mental privacy should not be intruded upon in any unjustified way by the application of any of these techniques.

In the evolving language of standards for human rights, it may also constitute "cruel, inhuman, or degrading treatment. Furthermore, credibility on the consequences of these techniques violates the right to a fair trial. It is not justified to erode fundamental rights for instance the right against self-incrimination based on a compelling public interest.

The techniques in question should never be forced on anyone in any proceedings whether it is criminal or civil. An inappropriate interference with personal liberty would result from such a move. However, if proper protections are in place, voluntary implementation of the controversial practices would be acceptable. The test results are not admissible as evidence, although the person upon whom the test has been applied, have consented thereto. The reason is, the person who is subject and consents for it, does not have conscious control over the responses during the test. Exception has been given under Section 27 of the Indian Evidence Act 1872 which legalised that any information or material facts that are later discovered as a result of voluntarily administered test may be proved and admissible. The Supreme Court of India laid down certain guidelines which have been published by National Human Rights Commission in 2000 on “Polygraph Test on an Accused”. It is also directed by the Court that these guidelines must be followed in every test and techniques such as “Norco Analysis Technique”, Brain Electrical Activation Profile”.

These prescribed guidelines are as follows:

[16] AIR 2010 SSC 1974, Per K.G. Balkrishnan C.J.I. R.V.Raveendran and J.M. Panchal JJ.

1. The accused person's consent is mandatory for administration of Lie-detector Test. He must be given a choice to undergo with the test voluntarily.
2. The person who is volunteers for Lie-Detector Tests may be physically, emotionally and legally damaged. The law enforcement agencies should discuss the potential results relating to physical, psychological and legal with the accused person and his attorney.
3. The consent given by the accused person for the test, must be recorded by judicial magistrate.
4. When the alleged agreement before the Magistrate was heard, the person should have a lawyer appear on his or her behalf.
5. The subject of the inquiry should also be informed that any statements they make to the magistrate will not be considered "confessional" statements; rather, they will be viewed as statements to the police.
6. The Magistrate must evaluate all circumstances of the detention, such as its duration and the type of questioning, before deciding whether to order release.
7. Lie-Detector tests must be recorded by an impartial agency (like a hospital) and must be administered with a lawyer present.
8. It is important to record specific medical information as well as details of how the information was acquired.

In the case of State of Bombay v. Kathi Kalu,[17] The Supreme Court opined that giving a finger impression or sample signature might be seen as giving evidence in the wide meaning of "to be a witness." In these circumstances, he is not providing firsthand testimony. They serve solely as comparative tools. Therefore, neither search warrant was used,[18] It would not be against the law to compulsorily take an accused person's photos, fingerprints, or specimen writing under Article 20(3).[19] According to Article 20(3), it is unlawful to compel someone to share information about the charge against them. The law of evidence has been significantly impacted by recent advances in science. The law of evidence tries to keep up with scientific knowledge and use its findings to determine the truth in a number of areas, including

(a) bloodstains,
(b) blood groups,
(c) alcohol and breath tests in case of traffic accidents,
(d) tape-recording,

[17] AIR 1961 SC 1808.
[18] M.P. Sharma v. Satish Chandra, AIR 1955 SC 300 at p.304.
[19] State of Bombay v. Kathi Kalu, AIR 1961 SC 1808.

(e) automatic photographs,

(f) computers,

(g) identification of fibres,

(h) including human hairs,

(i) arson investigation,

(j) truth drugs and lie-detectors, and

(k) finger and footprints.

BLOODSTAINS AND BLOOD GROUPS

Every human being has blood which belongs to one of four major groups--A, B, AB and O, differentiated by the presence or absence in the corpuscles and serum, of certain substances (agglutinogens and agglutinins). When blood from incompatible groups is mixed, agglutination or sticking together of red corpuscles occurs which may lead to fatal results. A compatible transfusion is ensured by using the blood from the same blood group or from Group O. The blood group is fairly easily determined by simple tests.

The expert evidence is a weak type of evidence and courts consider it unsafe to rely on it without independent and reliable corroboration.[20] The expression "science or art" in Section 45 is of wide import and cannot have a narrow meaning. It includes the study of type-writing, that is, whether a particular type of script came from a particular type-writer.

The reason it was not mentioned in the section may be because type-writers had not become common in 1872 when the Act was passed. "Handwriting should be interpreted as including type-writing since type-writing is now more common than handwriting'[21].

2. Research Problem

The integration of forensic evidence under India's Bharatiya Sakshya Adhiniyam, 2023 introduces multifaceted challenges within the legal system, encompassing issues related to admissibility, reliability, and practical application in criminal justice. A central problem lies in ensuring the admissibility and reliability of forensic evidence. The absence of standardized protocols for methods like DNA analysis, fingerprinting, and digital forensics creates difficulties for courts to weigh such evidence effectively. Additionally, maintaining the integrity of the chain of custody is critical, as any lapses in evidence handling or storage can compromise authenticity. Another

[20] S. Gopala Reddy v. State of A.P.,(1996) 4 SCC 596: 1996 SCC (Cri) 792.
[21] State v. S.J.Chaudhary, (1996) 2 SCC 428: 1996 SCC (Cri) 336.

pressing issue is the lack of standardization in forensic practices, with inconsistent methodologies across laboratories undermining the credibility and fairness of forensic analysis in trials. Furthermore, the complex nature of forensic evidence often necessitates expert testimony, but limited judicial understanding of scientific principles can lead to flawed interpretations. Ethical concerns also arise, including privacy violations, wrongful convictions, and misuse of forensic technologies, particularly in cases involving sensitive data such as DNA evidence. These issues highlight the urgent need for reforms to ensure forensic evidence is reliable, standardized, and ethically handled.

3. Literature Review

A systematic Literature review is conducted in which the articles published in the indexed journals of Web of Sciences (WOS), Scopus, were considered. Additionally, Shodhganga, platform was searched to review the related thesis. The query contained the following keyword strings :("Forensic") AND ("dna") AND ("justice ") AND ("Investigation"))))198 articles from Scopus and 39 articles from WoS database were retrieved for the literature review.

The details for the same have been given below

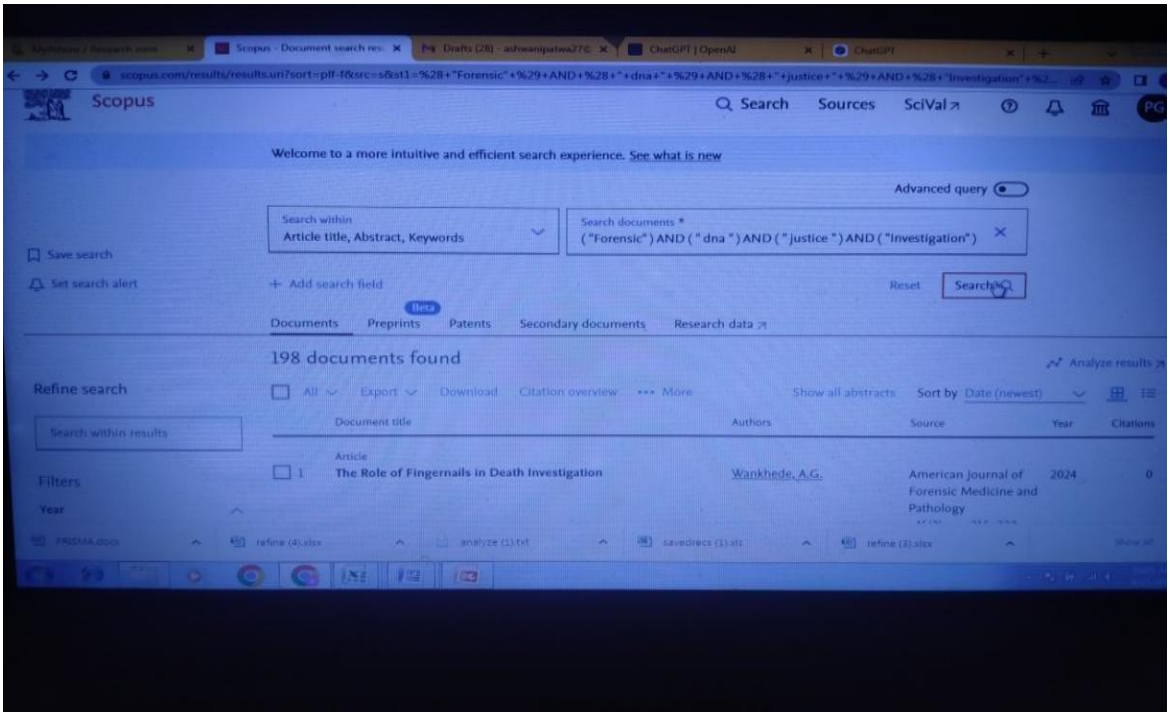


Figure 1: Query Result of Scopus database for Literature Review

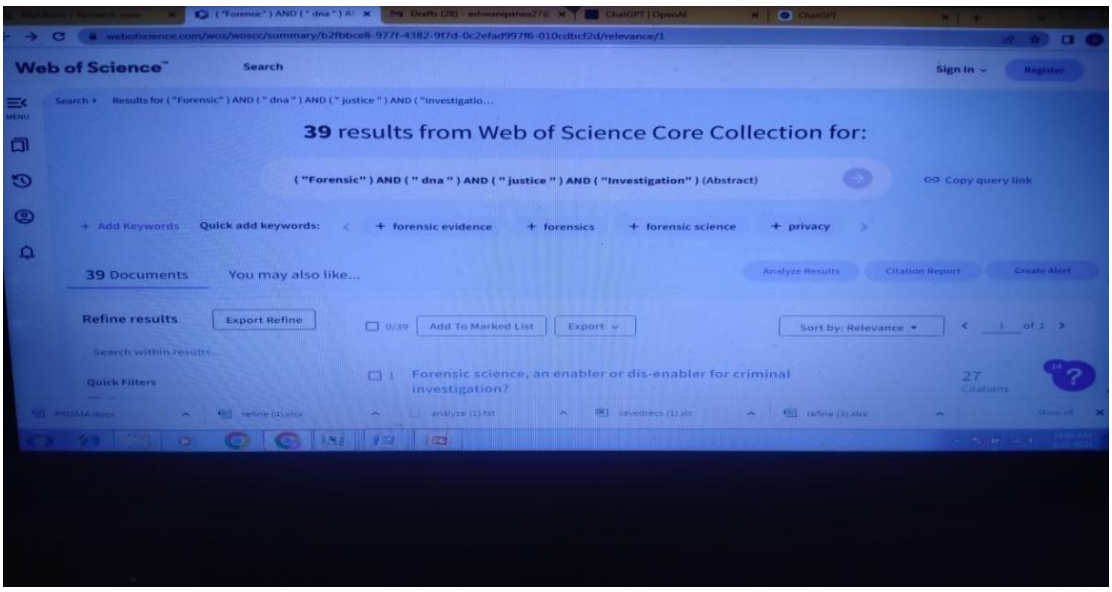
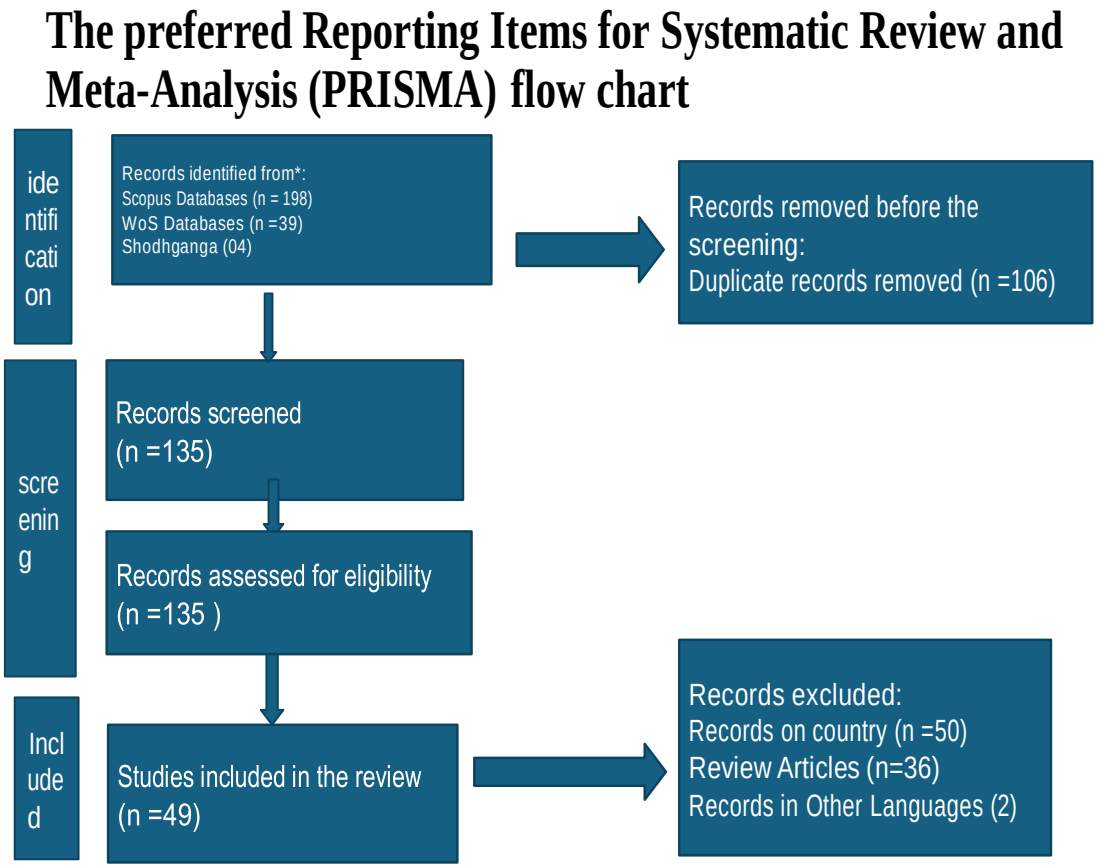


Figure 2: Query Result of Web of Science (WoS) database for Literature Review



Thematic categorization of the literature review-

3.1. **Forensic Science and Its Role in the Legal System**

3.1.1 **The Evolution and Role of Forensic Evidence in Criminal Justice**

- **Forensic Science in India**: Early studies on forensic science in India (e.g., **Rajesh B. Jadhav, "The Role of Forensic Science in Indian Criminal Investigations"**) highlight how forensic tools such as fingerprint analysis, DNA testing, and toxicology have been employed in criminal investigations. The effectiveness of forensic evidence in solving crimes and ensuring convictions has been well documented in these studies.
- **Importance of Scientific Evidence**: **M.S. Vasanthan** (2015) in his book "Forensic Evidence and Indian Judiciary" emphasizes the indispensable role of forensic science in solving crimes and reinforcing the judicial system. He explains that forensic evidence provides objective and scientific backing to witness testimonies and circumstantial evidence in criminal trials.
- **The Rise of DNA Evidence**: Literature also underscores the growing significance of DNA profiling in India's criminal justice system. **S.V. Venkatesh** (2017) in his article "DNA Profiling in India: A Legal and Forensic Perspective" argues that DNA evidence has revolutionized criminal investigations, particularly in cases of sexual assault and homicides.

3.1.2 **Forensic Evidence in the Indian Evidence Act**

- **Legal Framework**: The **Indian Evidence Act, 1872** includes provisions for the use of forensic evidence under **Section 45 (Expert Opinion)** and **Section 46 (Admissibility of Expert Evidence)**. Legal scholars such as **R.K. Jain** and **S.L. Khurana** (2016) have analyzed how forensic evidence is treated under these provisions, noting that while expert testimony is admissible, the evidentiary value depends heavily on the credentials of the forensic experts and the proper handling of the evidence.
- **Case Law Review**: Studies like **"Forensic Evidence in the Indian Courtroom" by A. Prakash (2019)**, review judicial interpretations on forensic evidence and its admissibility. These authors argue that courts often face challenges in understanding complex forensic techniques, leading to inconsistent rulings.

3.2. Challenges in Forensic Evidence Application

3.2.1 Lack of Standardization and Training

- **Quality of Forensic Evidence**: **M.P. Jain** (2015) in "Indian Judicial System and the Reliability of Forensic Evidence" points to the lack of standardization across forensic labs in India. Many forensic laboratories still lack the necessary accreditation or standardized procedures for evidence collection, leading to doubts about the accuracy and reliability of the results.
- **Training of Judicial Officers**: Scholars like **Nikita B. Mehra** (2018) have written extensively about the need for **judicial training** to interpret and evaluate forensic evidence accurately. In her study "The Role of Judges in Forensic Evidence Interpretation: Need for Training", she argues that many judges are not well-versed in scientific evidence, which may lead to misinterpretations of forensic findings.

3.2.2 Ethical Issues and Concerns

- **Ethics in Forensic Science**: **Rina V. Agrawal** (2020) in "Ethical Dilemmas in Forensic Investigations" discusses ethical concerns arising from the misuse of forensic evidence, particularly in controversial techniques such as polygraph tests and narco-analysis, which may violate the constitutional rights of the accused.
- **Privacy and Human Rights**: **Amit Sharma** (2022) raises issues related to privacy violations in the use of DNA evidence in "Forensic Science, Privacy, and Human Rights". He advocates for strict guidelines regarding consent and privacy, especially in sexual assault and paternity testing cases.

3.2.3 Chain of Custody and Integrity

- **Forensic Evidence Integrity**: **Nitin P. Roy** (2021) in "Challenges in Maintaining Chain of Custody in Forensic Investigations" analyzes the problems with the chain of custody in India’s forensic investigations. Lack of proper handling and documentation during evidence transfer, or contamination of samples, can invalidate forensic evidence and lead to wrongful acquittals or convictions.

3.3. Judicial Interpretation of Forensic Evidence

3.3.1 Role of Judges in Admissibility of Forensic Evidence

- **Judicial Approach to Expert Evidence**: **Dilip Kumar** (2017) in his paper "Forensic Science in Indian Courts: The Role of Experts" discusses the judicial attitude towards forensic evidence in Indian courts. He examines how judges typically accept forensic evidence as expert opinion but often fail to independently assess its validity.
- **Case Law Analysis**: **Lalit K. Soni** (2019) in "Judicial Scrutiny of Forensic Evidence: A Critical Review" evaluates several significant cases in India where forensic evidence influenced the outcome of trials. For example, in the **Rajesh Gautam case**, the court emphasized the reliability of forensic evidence like DNA testing, setting a precedent for its growing importance.

3.3.2 Judicial Challenges and Misuse of Forensic Evidence

- **Misuse and Misinterpretation**: **Raghvendra B. Rai** (2018) in "Forensic Evidence in India: Judicial Failures and Their Impact on Justice" outlines cases where forensic evidence was either misused or misinterpreted, leading to acquittals or wrongful convictions. He notes that many judges are often unfamiliar with forensic procedures, which can cause legal missteps and affect the outcome of trials.

3.4. Forensic Evidence in Specific Criminal Cases

3.4.1 DNA Evidence in Sexual Offenses and Homicides

- **Use in Sexual Assault Cases**: Several studies focus on how forensic evidence, particularly DNA, has been used in **sexual assault** and **homicide** cases. **Ayesha K. Banu** (2018) in "Forensic DNA Evidence in Rape Cases in India" argues that DNA evidence has been instrumental in providing irrefutable proof of the perpetrator’s identity, but its limited availability due to insufficient forensic infrastructure hampers its widespread application.
- **Landmark Cases**: Studies like **"Forensic Evidence in Landmark Indian Cases" by Suresh K. Gupta** (2019) provide in-depth analyses of major criminal cases where forensic science played a key role in proving guilt or innocence. These cases include **Pawan Kumar v. State of Haryana** (2008), where DNA evidence was pivotal in securing a conviction.

3.4.2 Forensic Evidence in Terrorism and Organized Crime

- **Counter-Terrorism Applications**: The **Delhi Blasts case** (2008) and **Mumbai Bombings case** (1993) are frequently cited in studies analyzing the use of forensic evidence in counter-terrorism. **Sudhir S. Yadav** (2020) in "The Role of Forensic Science in Counter-Terrorism in India" emphasizes how forensic evidence, such as explosive residue and DNA samples, is increasingly critical in the prosecution of terrorism-related crimes.

3.5. Technological Innovations in Forensic Science

3.5.1 Digital Forensics and Cybercrime

- **Emerging Trends**: With the rise of cybercrimes, **digital forensics** has gained prominence in India's criminal investigations. **Amit R. Shah** (2021) in "The Role of Digital Forensics in Cybercrime Investigations" discusses how digital evidence such as emails, social media activity, and IP address logs are increasingly being used to solve cybercrimes, though challenges remain in their legal admissibility under the **Indian Evidence Act**.
- **Admissibility of Digital Evidence**: **Vikram Singh** (2020) explores the challenges in making digital evidence admissible in court, particularly focusing on the **Information Technology Act** and its intersection with the Indian Evidence Act in ensuring proper authentication of electronic records.

3.5.2 New Forensic Technologies

- **Emerging Techniques**: Scholars like **Neha K. Mehta** (2022) have written about new forensic techniques like **3D crime scene reconstruction**, **advanced toxicology**, and **biometric identification**. These techniques, though in early stages in India, are seen as promising tools to improve the effectiveness of forensic science in criminal justice.

3.6. Policy Reforms and Recommendations

3.6.1 Need for Legal Reforms in Forensic Evidence Handling

- **Reforming the Evidence Act**: **Kavita D. Mishra** (2020) in her paper "Reforming the Indian Evidence Act for Forensic Evidence" argues that there is a pressing need for

amendments to the Indian Evidence Act to accommodate newer forensic techniques and improve their admissibility in courts. Mishra suggests that the Evidence Act must be updated to address issues like **electronic evidence**, **DNA evidence**, and **genetic databases**.

- **Forensic Accreditation**: Experts like **Ravi K. Choudhury** (2021) in "Forensic Laboratories and Accreditation in India" stress the need for national standards and accreditation bodies for forensic labs to ensure the accuracy, reliability, and accountability of forensic evidence.

3.6.2 Judicial Training and Awareness

- **Training for Judges and Lawyers**: **Vishal Sharma** (2021) advocates for specialized training programs for judges, lawyers, and law enforcement agencies in the area of forensic science to help them better understand and interpret scientific evidence.
- **"DNA Test in Criminal Investigation, Trial and Paternity Disputes"**
  Authors: Yashpal Singh and Mohammad Zaidi, Alia Law Agency, Allahabad, 2006
  This book explores various aspects of DNA technology, including explanations of legal and scientific terms, historical development, and the conflict between DNA technology and human rights, particularly regarding privacy in paternity disputes. It also covers legislative and judicial perspectives on DNA evidence in multiple countries, analyzing relevant laws and judicial pronouncements from both developed and developing nations, such as the USA, UK, New Zealand, Canada, and Australia.
- **"A Litigator's Guide To DNA (From Laboratory To Courtroom)"**
  Authors: Ron C. Michaelis, Robert G. Flanders, Paula H. Wulff, Elsevier Inc. (Academic Press, UK), 2004
  This guide details forensic DNA technology, databases, and the courtroom application of DNA evidence. It includes a dedicated chapter on the admissibility of DNA evidence, presenting arguments for both prosecution and defense. The book also discusses post-conviction techniques and their implications in various legal systems, providing comprehensive insights into the challenges faced in the application of DNA technology.
- **"Forensic DNA Typing"**
  Author: John M. Butler, Elsevier Academic Press, UK, 2005
  This work covers the basic biology of DNA, methods of extraction, and crucial issues such as degradation and contamination, which can impact case outcomes. It provides an

in-depth analysis of CODIS (Combined DNA Index System) and discusses the use of DNA databases in foreign countries, highlighting implementation challenges.

- **"Forensic Science: An Introduction to Scientific and Investigative Techniques"**
  Authors: Stuart H. James and Jon J. Nordby, CRC Press, London, 2005
  This book outlines DNA technology and its legal implications, including standards for admissibility in various legal systems. It discusses federal rules related to DNA technology and addresses socio-legal issues surrounding the use of DNA evidence in criminal cases.
- **"DNA Technology in Administration of Justice"**
  Author: Jyotirmoy Adhikary, Lexis Nexis Butterworths, New Delhi, 2007
  This book presents a comparative analysis of the growth of DNA testing and databanks in developed countries. It explains the development of DNA fingerprinting as a forensic tool and discusses the dilemmas faced by Indian courts in evaluating DNA evidence, offering insights into technology and implementation challenges within the Indian legal system.

4. Research Gaps

On the basis of extensive literature review, the following gaps have been identified: -

4.1. **Admissibility, Standardization and Validation of Forensic Evidence**

- **Gap:** How do the provisions of the Bharatiya Sakshya Adhiniyam, 2023, define the admissibility of forensic evidence? Although forensic science is increasingly used in Indian courts, there is still a lack of standardized protocols for various forensic techniques (such as DNA analysis, fingerprinting, toxicology, and digital forensics) across different states and laboratories.
- **Need for Research:** More research is needed to identify gaps in the standardization of forensic procedures and to develop national guidelines for the admissibility of forensic evidence. This includes validating the reliability of new and emerging forensic methods and ensuring their consistency across forensic laboratories.

4.2. Improvement in Chain of Custody Protocols

- **Gap:** One of the main issues in forensic evidence handling is maintaining an unbroken chain of custody. Despite existing protocols, breaches and lapses are common, and these

can undermine the integrity of the evidence.

- **Need for Research:** Research on the development of more robust and secure chain-of-custody systems is essential, particularly in terms of digitization and technological solutions (such as blockchain) to track evidence from collection to presentation in court.

4.3. Judicial Acceptance and Interpretation:

Gap: To what extent do courts accept and rely on forensic evidence in their decision-making process? What challenges arise during trials regarding the interpretation of forensic findings?

- **Need for Research:** Studies on how the judiciary and legal professionals can be better trained in understanding forensic evidence are essential. Further, conducting research on how courts can ensure they effectively evaluate and weigh forensic evidence in their decisions is must needed.

4.4. **Ethical and Privacy Concerns in Forensic Evidence**

- **Gap:** In the literature, there is less work on the collection and use of forensic evidence, especially sensitive data like DNA or digital records, raise serious privacy and ethical issues and therefore, the lack of clear guidelines on consent, data protection, and the potential misuse of forensic evidence still remains a significant concern to the society.
- **Need for Research:** Research on ethical guidelines for the use of forensic evidence in the judicial system is very crucial which includes addressing privacy issues related to DNA databases, digital surveillance, and biometric data and hence further studies are needed to determine how Indian legal system can be balanced with the need for effective criminal investigations with the protection of individual rights.

4.5. **Public Perception and Trust in Forensic Evidence**

- **Gap:** Public trust in the procedure of forensic evidence can vary subject on the perceived fairness and transparency of its application in the criminal cases. Cases of wrongful convictions or the misuse of forensic evidence can demoralize public confidence towards the justice system.
- **Need for Research:** Research on the role of public perception and education about forensic science in criminal trials is required. Understanding how public trust in forensic evidence

can be boosted, and how to prevent or address cases of wrongful convictions, is vital to strengthening the judicial process and public trust as well.

5. Research objectives

RO1. To Analyze the Current Legal Framework for the Admissibility of Forensic Evidence and to Assess the Reliability and Standardization of Forensic Practices in India.

RO2. To evaluate the perception of the Judiciary to Understand and Interpret Forensic Evidence.

RO3. To assess the Challenges in Maintaining the Chain of Custody, the Effectiveness of Forensic Evidence in Gender-Based and Sexual Offense Cases for Forensic Evidence and also Identify ethical privacy Concerns Regarding Forensic Evidence

RO4. To Propose Recommendations for Legal and Procedural Reforms in the Use of Forensic Evidence

6. Research Hypothesis

On the basis of Research questions and the literature reviewed the following are hypothesis-

H1: The legal framework established by the Bharatiya Sakshya Adhiniyam, 2023, enhances the standards for the admissibility, collection, and preservation of forensic evidence, thereby increasing its acceptance in judicial proceedings.

H2: The use of forensic evidence in trials enhances public trust in the criminal justice system, fostering fairness and effectiveness, while ongoing training and adherence to best practices, as outlined in the Bharatiya Sakshya Adhiniyam, 2023, improve the reliability and outcomes of judicial proceedings.

7. Research Methodology

The methodology section outlines the systematic approach to be followed in conducting the research. Given the multidisciplinary nature of the study, which bridges law, forensic science, ethics, and policy, the methodology will employ a **mixed-methods approach** combining both **qualitative** and **quantitative** research techniques to gather, analyze, and interpret data.

The study will use a **descriptive-analytical** research design, combining doctrinal legal research with empirical data collection. This approach will allow for both theoretical analysis and practical insights.

- **Doctrinal Legal Research**: The legal framework surrounding forensic evidence under the Indian Evidence Act will be critically analyzed through case law, statutes, legal texts, and scholarly articles. This will help identify gaps in the current legal system and propose reforms.

The following major and minor legislations will be focused on the research works-

Major Legislation-

1. Bharatiya Sakshya Adhiniyam, 2023
2. Bharatiya Nagarik SurakshyaSanhinta, 2023
3. Indian Constitution

Criminal Minor Legislations

- The Arms Act, 1959
- The Dowry Prohibition Act, 1961
- The Explosives Act, 1884
- The Explosive Substances Act, 1908
- The Narcotic Drugs and Psychotropic Substances Act, 1985
- The Poisons Act, 1919
- The Protection of Women from Domestic Violence Act, 2005
- The Medical Termination of Pregnancy Act, 1971
- The Weapons of Mass Destruction and their Delivery Systems (Prohibition of Unlawful Activities) Act, 2005
- Information Technology Act, 2000

- **Empirical Research**: The study will also use empirical methods (such as surveys, interviews, and case studies) to understand the practical application of forensic evidence in Indian criminal cases, particularly with regard to its effectiveness, challenges, and judicial

treatment. An self-structured questionnaire will be designed in line with the proposed objectives. Responses will be taken from legal-professionals, forensic expert and general public. The sample size will be calculated using following formula:

$$n = \left(\frac{z * \sigma}{e}\right)^2$$

Where,

Z=Alpha level (1.96 at 5% level of significance)

$\boldsymbol{\sigma = Standard\ Deviation}$

e=acceptable margin of error

Purposive and convenience sampling are widely recognized as common sampling methods in social science research (Etikan et al., 2016; Suen et al., 2014; Collins et al., 2006; Mohr, 1990). This study employs these techniques to select credit professionals, aiming to gain insights into their perspectives on individual credit scoring factors. To ensure uniformity in geographic representation and employee diversity, the survey encompasses participants from across India. Descriptive statistics will be employed to summarize and highlight the fundamental characteristics of the participants. Furthermore, depending on the fulfillment of assumptions, both parametric and non-parametric tests will be conducted to assess the significance levels of the variables under investigation. Data analysis will be performed using SPSS and Jamovi software.

8. Signification of the Study

The significance of this research lies in addressing critical gaps in the integration and application of forensic evidence within India's legal framework. By analyzing the current legal provisions and evaluating the reliability and standardization of forensic practices, the study highlights systemic challenges that impact the admissibility of forensic evidence in courts in the light of new legislations. It emphasizes the need for consistency and credibility in forensic methodologies, which are essential for ensuring fairness in.

Apart from that, the study examines the judiciary's perception to understand and interpret forensic evidence, shedding light on potential knowledge gaps that may lead to misinterpretation of scientific findings. This evaluation is crucial for enhancing judicial decision-making and fostering trust in forensic evidence.

Moreover, the research explores challenges in maintaining the chain of custody and the role of forensic evidence in gender-based and sexual offense cases, emphasizing the importance of preserving evidence integrity. It also addresses ethical concerns, such as privacy and consent, ensuring that forensic practices align with ethical standards.

Ultimately, the study aims to propose actionable recommendations for legal and procedural reforms, contributing to a more robust and ethical use of forensic evidence in India's criminal justice system. This research has the potential to enhance justice delivery and safeguard individual rights.

9. Tentative Chapterisations

Considering the all aspects and to facilitate the discussion and solution for above problems and for development of structure of work, the work would be divided into VII chapters and proposed chapters of this thesis are as follows:

Chapter 1: Introduction

- **1.1 Background and Rationale**
    - Overview of the role of forensic evidence in criminal investigations and trials in India.
    - The significance of forensic science in ensuring justice and the evolving legal and scientific landscape.
- **1.2 Objectives of the Study**
    - Clear articulation of the research objectives, including examining the legal framework, identifying challenges, and proposing improvements.
- **1.3 Research Questions and Hypotheses**
    - Specific research questions and hypotheses that the study aims to explore.
- **1.4 Scope of the Study**
    - Delimitation of the study in terms of geographical, legal, and forensic boundaries.
- **1.5 Methodology**
    - Outline of the research design, including qualitative and quantitative methods, case study analysis, and data collection techniques.
- **1.6 Structure of the Thesis**
    - Brief overview of the content and organization of the following chapters.

Chapter 2: Historical Framework for Forensic Evidence in India

- **2.1 Overview of the Forensic Evidence**
    - Historical development and evolution of the forensic evidence
    - basic provisions of the criminal legislation related to forensic evidence
- **2.2 The Role of Forensic Evidence in Criminal Justice**
    - The importance and scope of forensic evidence in proving facts in criminal cases.
- **2.3 Types of Forensic evidences**
- **2.4 Gaps and Ambiguities in the Legal Framework**
    - Identification of legal gaps, inconsistencies, or ambiguities related to forensic evidence.

Chapter 3: Legal Framework of Forensic Evidence

- **3.1 Categorically analysis of the basic provisions relating to forensic evidence in Bharatiya Sakshya Adhiniyam, 2023.**

  The key focus on Section 39, 40 and others provisions of Bharatiya sakshya Adhiniya, 2023

- **3.2 Analysis of the basic provisions relating to forensic evidence in BharatiyaNagarik Suraksha Sanhita, 2023.**
- key focus on Section 176, Section 52, Section 51, Section 184, Section 329 Section 291.
- **3.3 Basic provisions of the Indian Constitution-** the key focus on Article 20(3), read with Article 21.
- **3.4 Important provisions of IT Act, 2000 and other minor legislations.**

Chapter 4: Judicial Understanding and Interpretation of Forensic Evidence

- **4.1 The Role of Judges in Admitting and Evaluating Forensic Evidence**
    - How courts currently approach forensic evidence in criminal trials.
- **4.2 Challenges in the Judicial Evaluation of Forensic Evidence**
    - Lack of technical expertise among judges and legal professionals leading to misinterpretation.
- **4.3 Judicial Precedents on Forensic Evidence**
    - Key case laws where forensic evidence was central to the judgment.
- **4.4 The Need for Specialized Training for Judges and Legal Practitioners**

- The importance of educating legal professionals in forensic science and related fields.

- **4.5 Interdisciplinary Collaboration between Forensic Scientists and Legal Professionals**
  - Benefits and challenges of creating a collaborative framework for forensic experts and legal professionals.
- **4.6 Recommendations for Improving Judicial Handling of Forensic Evidence**
  - Proposals for training programs, guidelines, and resources to enhance the understanding and interpretation of forensic evidence.

Chapter 5: Contemporary Issues relating to Forensic evidence

- **5.1 Ethical Issues in Forensic Science**
  - Ethical considerations in the collection, handling, and use of forensic evidence, including issues related to consent and confidentiality.
- **5.2 Privacy and Human Rights in Forensic Evidence**
  - The intersection of forensic science and privacy rights, particularly in sensitive cases involving DNA or digital evidence.
- **5.3 Legal Protections for Privacy and Consent**
  - Existing laws and regulations on privacy and consent related to the collection of forensic evidence.
- **5.4 The Use of Forensic Data in Gender-Based and Sexual Violence Cases**
  - Ethical challenges in the handling of forensic evidence in sexual violence or gender-based violence cases.
- **5.5Legal Provisions for Admissibility of New Forensic Methods**
  - Analysis of how existing legal provisions accommodate or fail to accommodate emerging technologies.
- **5.6 Challenges in Adapting Legal Frameworks to Emerging Technologies**
  - Legal challenges related to the integration of new forensic technologies into the courtroom.
- **5.7 Standardization and Protocols in Forensic Science**
  - The role of standardization in ensuring the accuracy and consistency of forensic evidence.

- **The Importance of Forensic Evidence in Gender-Based and Sexual Offenses**
    - The role of forensic evidence in cases of sexual assault, domestic violence, and other gender-based crimes.

Chapter 6: Effectiveness of forensic evidence: A practical approach

In this chapter, practical aspects relating to forensic evidence will be observed through empirical study.

Chapter 7: Conclusions and Policy Recommendations

- **7.1 Summary of Key Findings**
    - Recap of the key findings from the research, including gaps in the legal framework, challenges in forensic practices, and the effectiveness of forensic evidence in the justice system.
- **7.2 Policy and Legal Recommendations**
    - Comprehensive policy recommendations to improve the use, reliability, and effectiveness of forensic evidence in India's criminal justice system.
- **7.3 Suggestions for Future Research**
    - Areas for further study on forensic science, legal reforms, and the evolving role of forensic evidence in the judicial process.
- **7.4 Final Thoughts**
    - Reflections on the importance of forensic evidence for ensuring justice and how reforming the legal framework can benefit society.

10 . Proposed Month-wise plan of work and targets to be achieved

S. No.	ACTIVITIES	Months-Year														
		Jan-25*	D-24	J-25	--	--	--	--	--	--	--	--	--	--	--	May-26
1	Thesis Proposal defense	Dec, 2024														
2	Extended Literature Review		Dec, 2024													
3	Questionnaire designing			Feb, 2025												
4	Pilot testing and refinement of															
5	Data collection															
9	Data preparation				March, 2025											
10	Data analysis & Results															
11	Report writing: Chapter:1 & 2 and 3……..		April- June 2025													
12	Report writing: Chapter 4, 5 and 6											July to August2025				
14	Thesis Writing, Publications and Other Requirements												Dec, 2025			
15	Thesis Submission															May, 2026

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Statutes-

Major Bare Acts-

1. Bharatiya Sakshya Adhiniyam, 2023
2. Bharatiya Nagarik SurakshyaSanhinta, 2023
3. The Constitution of India Bare Act.

Criminal Minor Legislations

- *The Arms Act, 1959*
- *The Dowry Prohibition Act, 1961*
- *The Explosives Act, 1884*
- *The Explosive Substances Act, 1908*
- *The Narcotic Drugs and Psychotropic Substances Act, 1985*
- *The Poisons Act, 1919*
- *The Protection of Women from Domestic Violence Act, 2005*
- *The Medical Termination of Pregnancy Act, 1971*
- *The Weapons of Mass Destruction and their Delivery Systems (Prohibition of Unlawful Activities) Act, 2005*
- *Information Technology Act, 2000*